The opinion in support of the decision being entered today was *not* written for publication in a law journal and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HISASHI OHTANI, MISAKO NAKAZAWA, and SATOSHI MURAKAMI

MAILED

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U.S. PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

Appeal No. 2006-1372
Application No. 09/197,767
Technology Center 2800

HEARD: October 18, 2006

Before JERRY SMITH, GROSS, and LEVY, *Administrative Patent Judges.*

GROSS, *Administrative Patent Judge.*

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1 through 5, 16, 22 through 27, 40, and 46 through 74, which are all of the claims pending in this application.

Appellants' invention relates to a semiconductor device having transistor, an interlayer insulating film, and a reflective pixel electrode over the insulating film. An embedded conductive layer fills a contact hole in the interlayer insulating layer to connect the pixel electrode with the transistor, and the surface of the embedded conductive layer is flush with the interlayer insulating layer. Claim 1 is illustrative of the claimed invention, and it reads as follows:

1. A semiconductor device comprising:

at least one transistor;

at least one interlayer insulating film formed over said transistor, said interlayer insulating film having at least one contact hole;

an embedded conductive layer provided to fill said contact hole wherein a top surface of said embedded conductive layer is flush with a top surface of said interlayer insulating film; and

a reflective pixel electrode having a flat upper surface thereon, formed on said interlayer insulating film wherein said reflective pixel electrode is electrically connected to said transistor through said embedded conductive layer,

wherein the embedded conductive layer comprises a conductive material dispersed in a medium, the conductive material being selected from the group consisting of carbon, zinc oxide, aluminum, and nickel.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Liu	5,536,950	Jul. 16, 1996
Miyawaki	5,644,370	Jul. 01, 1997
Fukunaga	5,706,064	Jan. 06, 1998
Yamazaki	5,990,542	Nov. 23, 1999 (Dec. 16, 1996)
Sato	6,081,305	Jun. 27, 2000 (May 21, 1996)
Okita	6,097,453	Aug. 01, 2000 (Jun. 02, 1997)
Izumi	6,400,428	Jun. 04, 2002 (Mar. 20, 1996)

Claims 1, 5, 16, 22 through 27, 40, 46, 47, 51, 55, 59, 63, 67, 68, 71, and 72 stand rejected under 35 U.S.C. § 103 as being unpatentable over Liu in view of Fukunaga and Izumi.

Claims 2, 22 through 27, 40, 48, 52, 56, 60, and 64 stand rejected under 35 U.S.C. § 103 as being unpatentable over Liu in view of Yamazaki, Fukunaga, and Izumi.

Claims 3, 22 through 27, 40, 49, 53, 57, 61, 65, 69, 70, 73, and 74 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sato in view of Okita, Fukunaga, and Miyawaki.

Claims 4 and 50 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sato in view of Okita, Miyawaki, and Yamazaki.

Claims 54, 58, 62, and 66 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sato in view of Okita, Miyawaki, Yamazaki, and Fukunaga

Claims 1, 2, 5, 22 through 27, 40, 47, 48, 51, 52, 55, 56, 59, 60, 63, 64, 67, 68, 71, and 72 stand rejected under 35 U.S.C. § 103 as being unpatentable over Fukunaga in view of Liu, and Izumi.

Reference is made to the Examiner's Answer (mailed June 16, 2005) for the examiner's complete reasoning in support of the rejections, and to appellants' Brief (filed March 17, 2005) and Reply Brief (filed August 18, 2005) for appellants' arguments thereagainst.

OPINION

We have carefully considered the claims, the applied prior art references, and the respective positions articulated by appellants and the examiner. As a consequence of our review, we will reverse the obviousness rejections of claims 1 through 5, 16, 22 through 27, 40, and 46 through 74.

The examiner begins (Answer, pages 3 and 9) by rejecting claims 1, 5, 16, 22 through 27, 40, 46, 47, 51, 55, 59, 63, 67, 68, 71, and 72 over Liu in view of Fukunaga and Izumi. The examiner asserts (Answer, pages 4 and 10) that although Liu's device has a transparent pixel electrode, it would have been obvious "to form Liu's pixel electrode either as a transparent electrically conductive film or as a reflective electrical conductive film, depending upon the desired display device type for the liquid crystal display device, as taught by Izumi."

As pointed out by appellants (Brief, page 9), Liu's objective is to create a better transmissive display. In particular, Liu discloses (column 1, lines 32-39) that present high resolution active matrix liquid crystal displays (AMLCDs) result in low aperture ratios, which requires a brighter backlight, which consumes extra power. Liu teaches (column 2, lines 36-38) that "a need exists for AMLCD pixel and transistor design that provide . . . [a] high pixel aperture ratio." Liu further discloses (column 6, lines 27-29) that the high aperture ratio achieved by his design "allows use of a lower power backlight and improves the display brightness and efficiency." To make Liu's pixel electrode

reflective would defeat the purpose of Liu's device. The Federal Circuit has held that "a proposed modification [is] inappropriate for an obviousness inquiry when the modification render[s] the prior art reference inoperable for its intended purpose. *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984)." *In re Fritch*, 972 F.2d 1260, 1265-1266 n.12, 23 USPQ2d 1780, 1783 n.12 (Fed. Cir. 1992). Therefore, we cannot accept the examiner's proposed modification of Liu. Consequently, we cannot sustain the obviousness rejection of claims 1, 5, 16, 22 through 27, 40, 46, 47, 51, 55, 59, 63, 67, 68, 71, and 72 over Liu in view of Fukunaga and Izumi.

The examiner (Answer, page 5) rejects claims 2, 22 through 27, 40, 48, 52, 56, 60, and 64 over Liu in view of Yamazaki, Fukunaga, and Izumi. Again the examiner proposes changing Liu's transparent pixel electrode to a reflective pixel electrode. As explained *supra*, such a modification would render Liu inoperable for its intended purpose. Accordingly, we cannot sustain the obviousness rejection of claims 2, 22 through 27, 40, 48, 52, 56, 60, and 64 over Liu in view of Yamazaki, Fukunaga, and Izumi.

Next the examiner (Answer, page 6) rejects claims 3, 22 through 27, 40, 49, 53, 57, 61, 65, 69, 70, 73, and 74 over Sato in view of Okita, Fukunaga, and Miyawaki. The examiner rejects (Answer, page 8) claims 4 and 50 over Sato in view of Okita, Miyawaki, and Yamazaki, and (Answer, page 9) claims 54, 58, 62, and 66 over Sato in view of Okita, Miyawaki, Yamazaki, and Fukunaga. The examiner (Answer, page 7) recognizes that Sato and Okita fail to teach the claimed materials for filling Sato's contact hole 171 through insulating layer 170. The examiner, therefore, turns to Fukunaga asserting (Answer, page 7) that Fukunaga discloses an embedded conductive layer of indium tin oxide or organic conductive layer of carbon or polymer to "provide a color liquid crystal display devices [sic] having high speed response, low power consumption, and low prices, as taught by Fukunaga et al (column 3, lines 30-34)."

Appellants argue (Brief, page 13) that Sato fails to teach or suggest that the embedded conductive layer and the reflective pixel electrode are formed as distinct features, as recited in the claims. Instead, according to appellants, Sato discloses that the

electrode itself fills the contact hole, and none of the additional references remedies this shortcoming of Sato. We agree with appellants.

Sato discloses (column 14, lines 5-23) that third metal layer 180 is formed on third insulating layer 170 and penetrates the insulating layer to contact the surface of the second metal layer below the insulating layer. Sato further states (column 13, lines 40-43) that third metal layer180 is "formed through insulating layer." The pixel electrode 181 is formed by patterning metal layer 180. Thus, Sato discloses forming as a single element the reflective pixel electrode and the conductive material which penetrates the insulating layer to connect the pixel electrode to the drain electrode. Nothing in Sato suggests forming the two portions separately and of different materials. Further, Okita discloses (column 7, lines 59-61) that metal electrode 108 is connected through hole 507 to transparent pixel electrode 508. Figure 6 of Okita shows no separation between pixel electrode 508 and the material in contact hole 507, and we find no disclosure in Okita that would suggest having the two elements separate. Thus, Okita does not remedy the deficiency of Sato.

Fukunaga discloses (column 40, line 65-column 41, line 20) that by using the functional layer as a flattening layer, high speed and response and high yield can be obtained. Further, the high degree of smoothness allows for a high aperture ratio, which lowers power consumption. Last, the use of the functional layer for the color filter reduces the number of manufacturing steps and the amount of material, which increases yield. In other words, it is not the material of the embedded conductive layer that yields high speed response, low power consumption, and low prices, as asserted by the examiner, but, rather, it is the color functional layer. Thus, Fukunaga fails to cure the deficiency of Sato.

Miyawaki discloses (column 7, line 67-column 8, line 11) that when an indium tin oxide pixel electrode is formed over an insulating layer, the indium tin oxide may not reach the transistor drain through the insulating layer resulting in a poor connection between the pixel electrode and the drain. Miyawaki teaches using a metal such as tungsten or aluminum, which will reach the drain through the insulating layer, thereby increasing the reliability of the liquid crystal display. Thus, Miyawaki suggests using

different materials for the pixel electrode and the interconnect when the pixel electrode is made of indium tin oxide, but we would have to resort to speculation to find that different materials should be used when the pixel electrode is made of metal. In other words, Miyawaki also fails to remedy the shortcomings of Sato, and we cannot sustain the rejection of claims 3, 22 through 27, 40, 49, 53, 57, 61, 65, 69, 70, 73, and 74 over Sato in view of Okita, Fukunaga, and Miyawaki.

The examiner rejects claims 4 and 50 over Sato in view of Okita, Miyawaki, and Yamazaki and claims 54, 58, 62, and 66 over Sato in view of Okita, Miyawaki, Yamazaki, and Fukunaga. Each of independent claims 4 and 50 includes the same limitations found lacking from the combination of Sato, Okita, Fukunaga, and Miyawaki. Yamazaki discloses (column 6, lines 7-9) that a contact hole is created in an insulating layer and then indium tin oxide is sputtered and patterned to fill the hole and form the pixel electrode. Thus, Yamazaki fails to suggest the use of separate materials for the pixel electrode and for filling the contact hole. Accordingly, Yamazaki does not remedy the deficiency of the above combination, and we cannot sustain the rejection of claims 4 and 50 over Sato in view of Okita, Miyawaki, and Yamazaki nor of claims 54, 58, 62, and 66 over Sato in view of Okita, Miyawaki, Yamazaki, and Fukunaga.

The examiner lastly rejects claims 1, 2, 5, 22 through 27, 40, 47, 48, 51, 52, 55, 56, 59, 60, 63, 64, 67, 68, 71, and 72 over Fukunaga in view of Liu, and Izumi. The examiner (Answer, page 3) relies on insulating layer 413/414 of Fukunaga for the insulating layer that is to be formed over the first conductive layer in each of the independent claims. Insulating layer 413/414 is used as a color filter by Fukunaga. If one were to make the second conductive layer (or pixel electrode) reflective, as suggested by the examiner (Answer, page 12) to make the device reflective, the color filter layer would no longer be functional, as light would be reflected before reaching the color filter layer. As this modification would render the prior art reference inoperable for its intended purpose, we cannot accept the examiner's proposed modification of Fukunaga. *See Id.* Therefore, we will not sustain the rejection of claims 1, 2, 5, 22 through 27, 40, 47, 48, 51, 52, 55, 56, 59, 60, 63, 64, 67, 68, 71, and 72 over Fukunaga in view of Liu, and Izumi.

CONCLUSION

The decision of the examiner rejecting claims 1 through 5, 16, 22 through 27, 40, and 46 through 74 under 35 U.S.C. § 103 is reversed.

REVERSED

JERRY SMITH
Administrative Patent Judge

ANITA PELLMAN GROSS
Administrative Patent Judge

STUART S. LEVY
Administrative Patent Judge

) BOARD OF PATENT APPEALS AND INTERFERENCES

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ERIC ROBINSON
PMB 955
21010 SOUTHBANK ST.
POTOMAC FALLS, VA 20165

APG/ki